

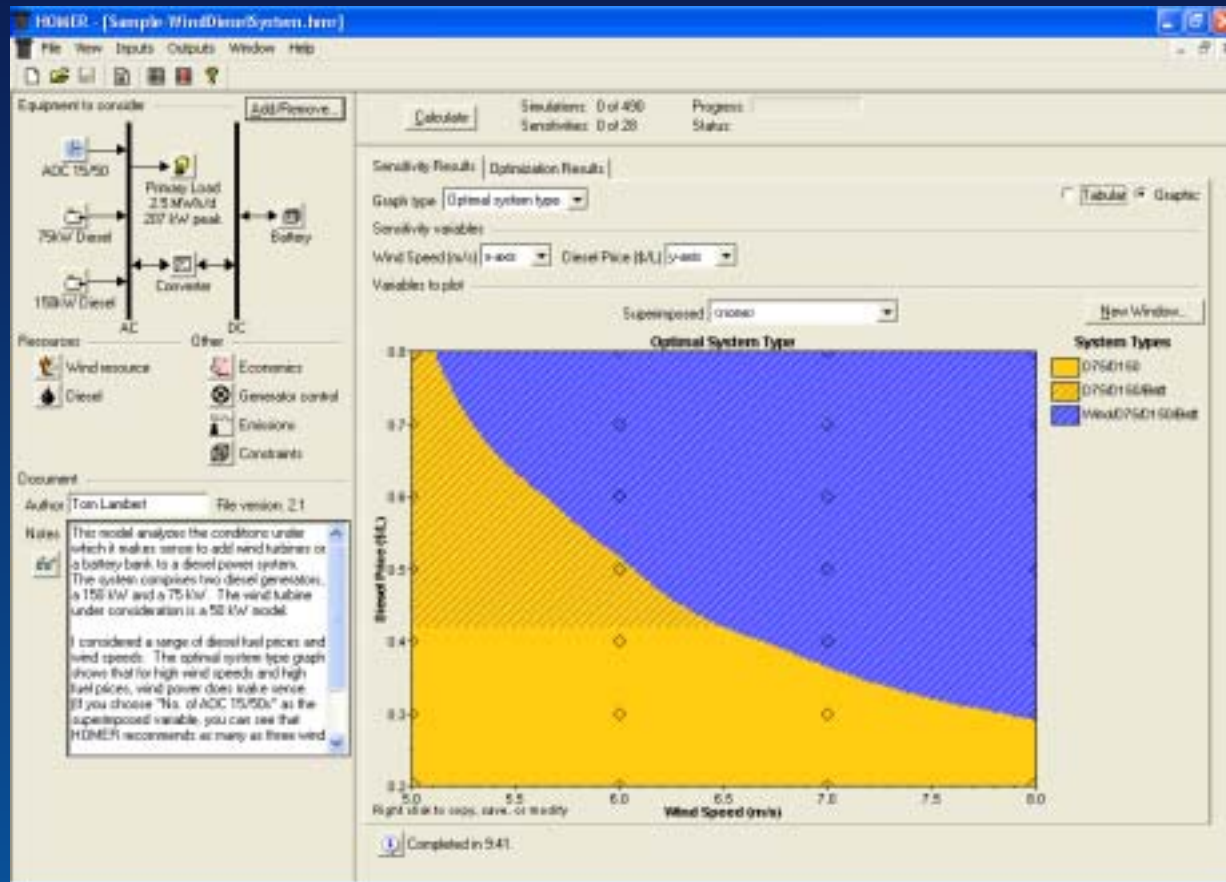
Wind-Diesel System Design with HOMER



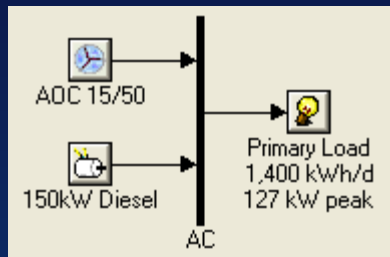
Tom Lambert
September 29, 2004

What is HOMER?

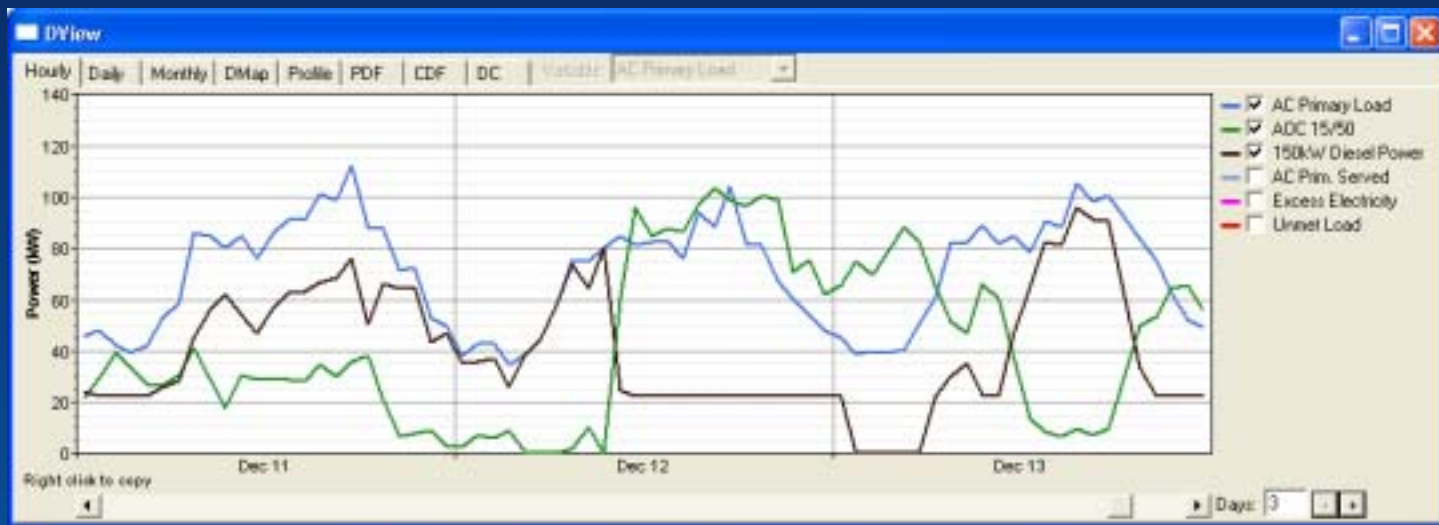
A tool for micropower system design and analysis



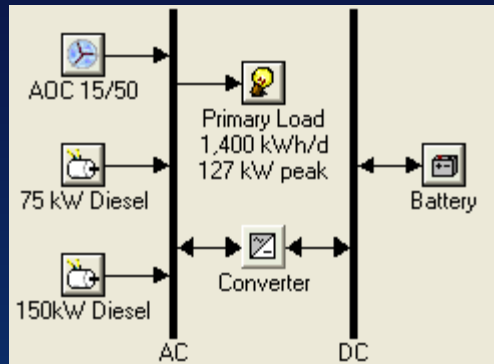
System Simulation



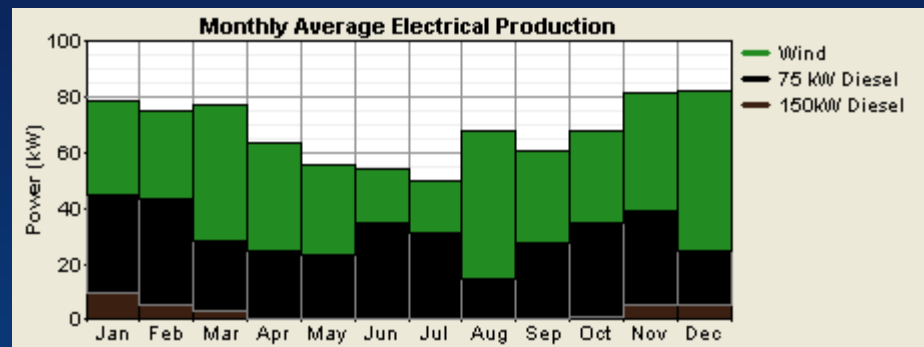
- Simulates many types of systems using a one-hour time step
- Considers operating reserve



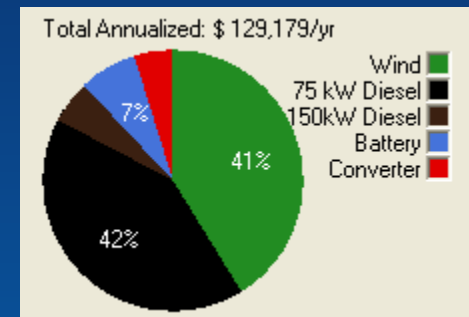
Technology Combinations



- Analyzes system performance and cost



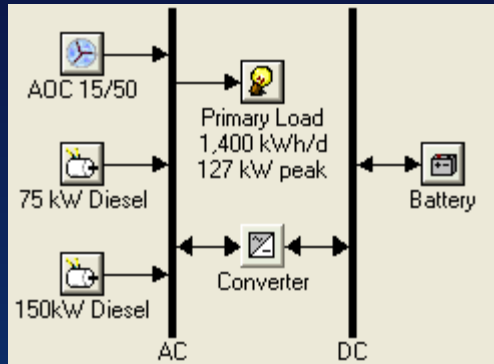
Component	Initial	Annualized	Annualized	Annual	Annual	Total
	Capital	Capital	Replacement	O&M	Fuel	Annualized
	(\$)	(\$/yr)	(\$/yr)	(\$/yr)	(\$/yr)	(\$/yr)
AOC 15/50	530,000	41,460	0	12,000	0	53,460
75 kW Diesel	30,000	2,347	1,984	368	49,183	53,882
150kW Diesel	40,000	3,129	-509	306	3,955	6,881
Battery	72,000	5,632	2,390	1,440	0	9,462
Converter	60,000	4,694	0	800	0	5,494
Totals	732,000	57,262	3,865	14,914	53,137	129,179



HOMER Calculates Life-Cycle Cost

- The total cost of a system over its useful life
 - Initial capital costs
 - Operating and maintenance costs
 - Fuel costs
 - Component replacement costs
 - Grid purchases and sales
 - Salvage value
- Expressed as a lump sum in "today's dollars"

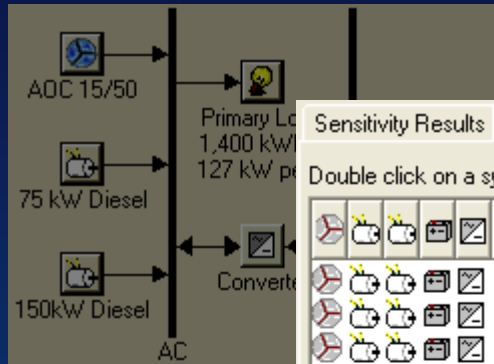
Optimization



- How many diesels?
- What size diesels?
- How many wind turbines?
- How many batteries?
- What size converter?
- What operating strategy?

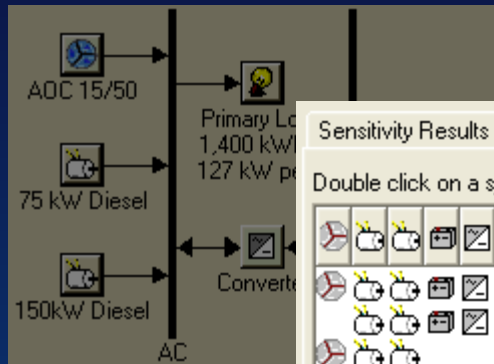
HOMER compares options based on life-cycle cost

Optimization Results



Sensitivity Results					Optimization Results												
Double click on a system below for simulation results.															<input type="radio"/> Categorized <input checked="" type="radio"/> Overall		Export
					15/50	D75 (kW)	D150 (kW)	Batt.	Conv. (kW)	Initial Capital	Total NPC	COE (\$/kWh)	Ren. Frac.				
					2	75	150	24	50	\$ 666,000	\$ 2,384,896	0.204	0.35				
					1	75	150	24	50	\$ 401,000	\$ 2,396,067	0.205	0.18				
					2	75	150	24	100	\$ 676,000	\$ 2,397,453	0.206	0.35				
					1	75	150	24	100	\$ 411,000	\$ 2,408,624	0.206	0.18				
					2	75	150	24	200	\$ 696,000	\$ 2,422,566	0.208	0.35				
					2	75	150	48	50	\$ 702,000	\$ 2,427,332	0.208	0.35				
					1	75	150	24	200	\$ 431,000	\$ 2,433,737	0.209	0.18				
					2	75	150	48	100	\$ 712,000	\$ 2,435,365	0.209	0.35				
						75	150	24	50	\$ 136,000	\$ 2,445,500	0.210	0.00				
					1	75	150	48	50	\$ 437,000	\$ 2,449,171	0.210	0.18				
						75	150	24	100	\$ 146,000	\$ 2,458,056	0.211	0.00				
					1	75	150			\$ 335,000	\$ 2,459,321	0.211	0.18				
						75	150			\$ 70,000	\$ 2,459,496	0.211	0.00				
					2	75	150	48	200	\$ 732,000	\$ 2,460,479	0.211	0.35				
					1	75	150	48	100	\$ 447,000	\$ 2,461,734	0.211	0.18				
					3	75	150	24	50	\$ 931,000	\$ 2,472,840	0.212	0.49				
					2	75	150			\$ 600,000	\$ 2,481,028	0.213	0.34				
						75	150	24	200	\$ 166,000	\$ 2,483,170	0.213	0.00				
					3	75	150	24	100	\$ 941,000	\$ 2,485,397	0.213	0.49				
					1	75	150	48	200	\$ 467,000	\$ 2,486,848	0.213	0.18				

Optimization Results



Sensitivity Results

Optimization Results

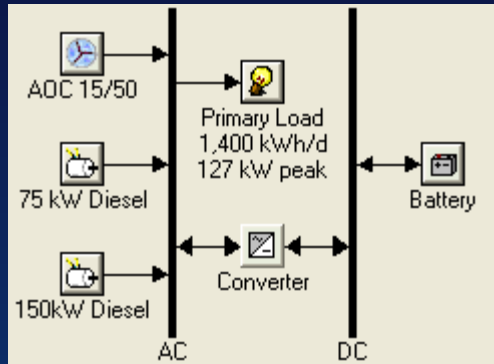
Double click on a system below for simulation results.

☒ Categorized
☐ Overall

Export

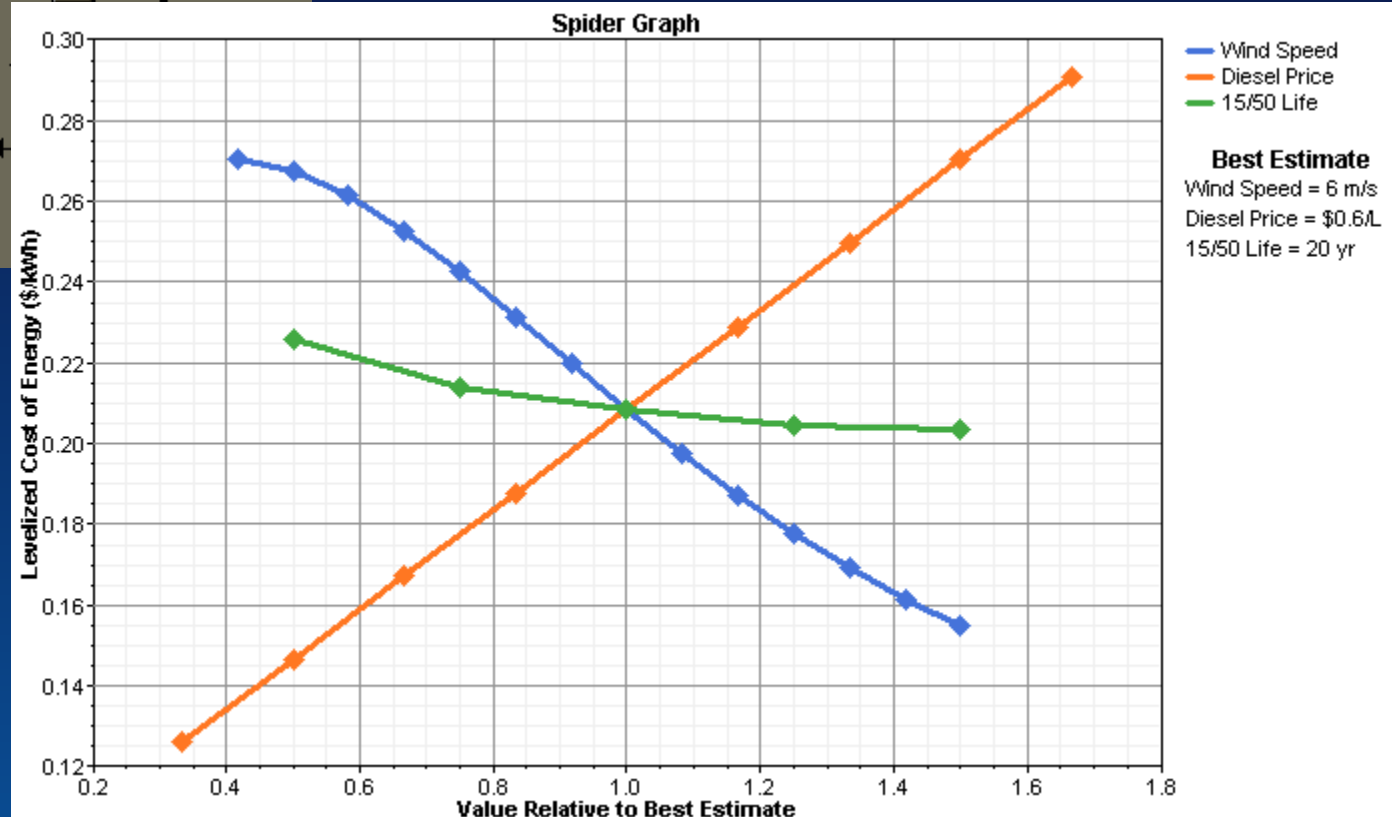
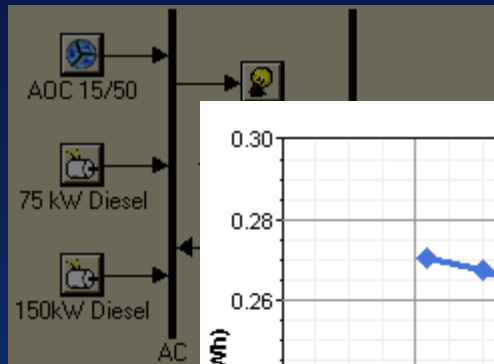
					15/50	D75 (kW)	D150 (kW)	Batt.	Conv. (kW)	Initial Capital	Total NPC	COE (\$/kWh)	Ren. Frac.	Diesel (L)
					2	75	150	24	50	\$ 666,000	\$ 2,384,896	0.204	0.35	188,145
						75	150	24	50	\$ 136,000	\$ 2,445,500	0.210	0.00	274,398
					1	75	150			\$ 335,000	\$ 2,459,321	0.211	0.18	240,910
						75	150			\$ 70,000	\$ 2,459,496	0.211	0.00	282,154

Sensitivity Analysis

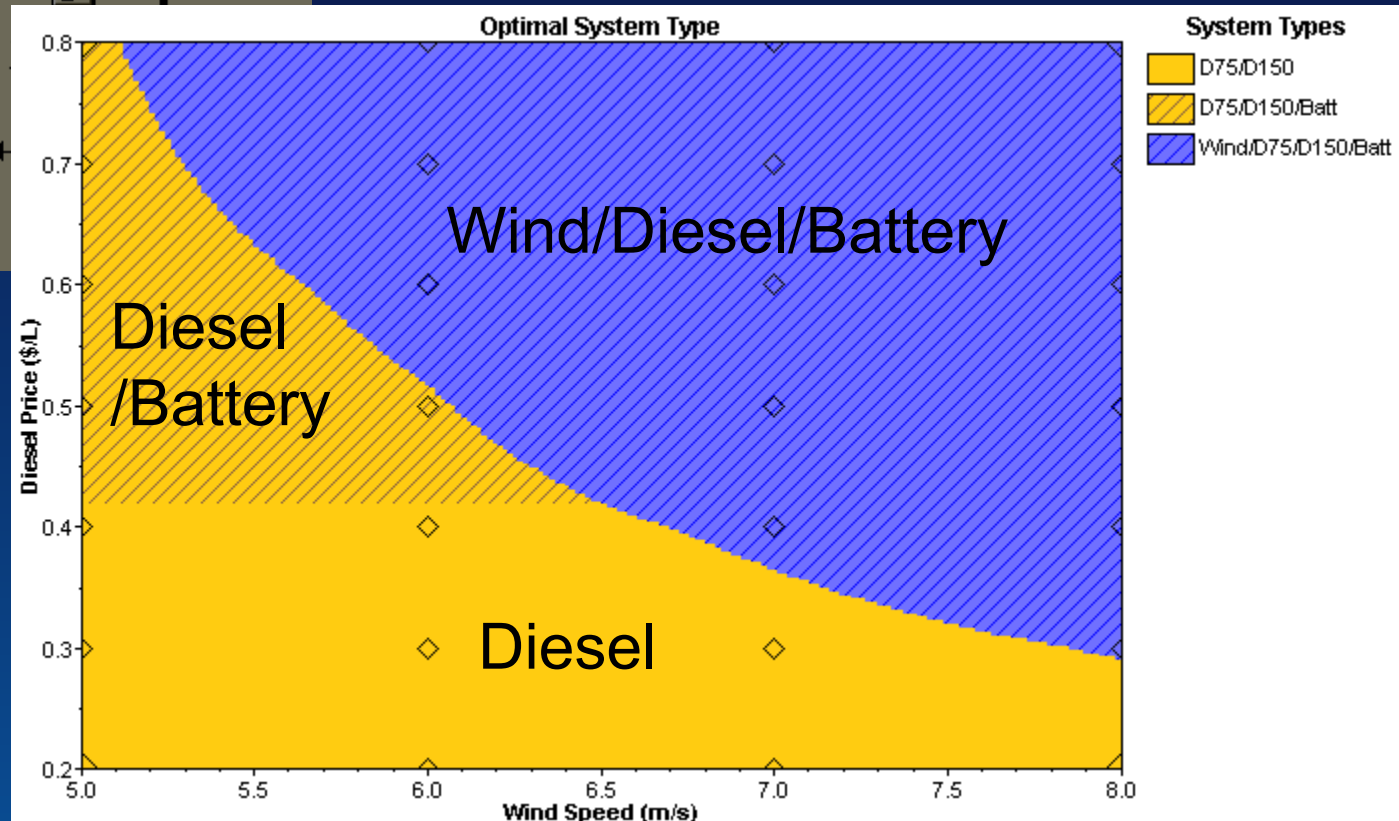
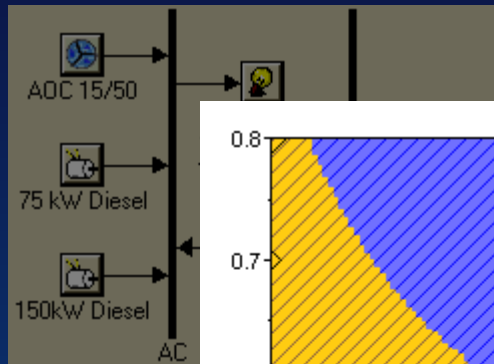


- Key variables may be uncertain
 - Wind speed
 - Fuel price
 - Wind turbine life
- What if our guesses are wrong?

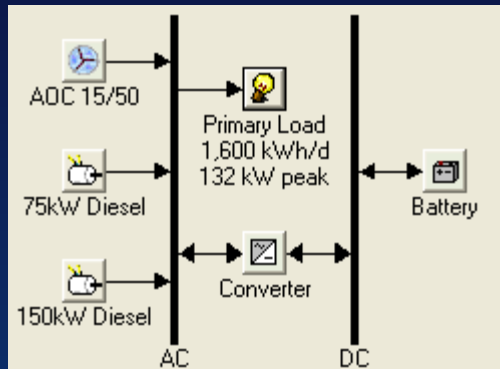
Sensitivity Analysis Results



Sensitivity Analysis Results

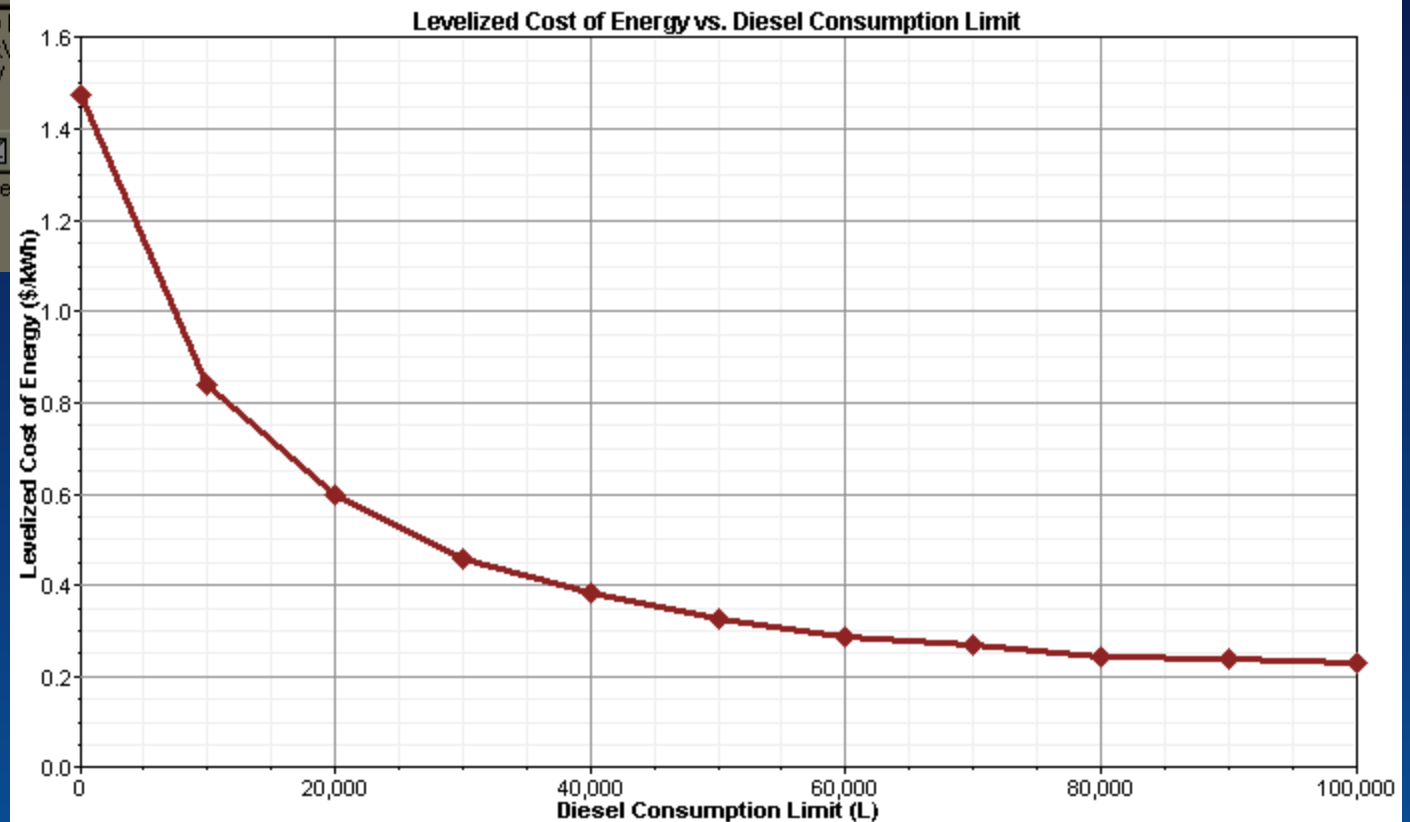
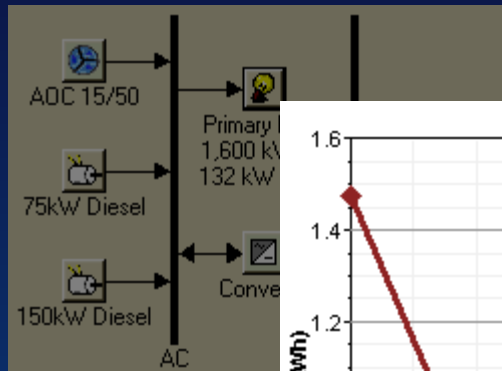


Sensitivity Analysis Example

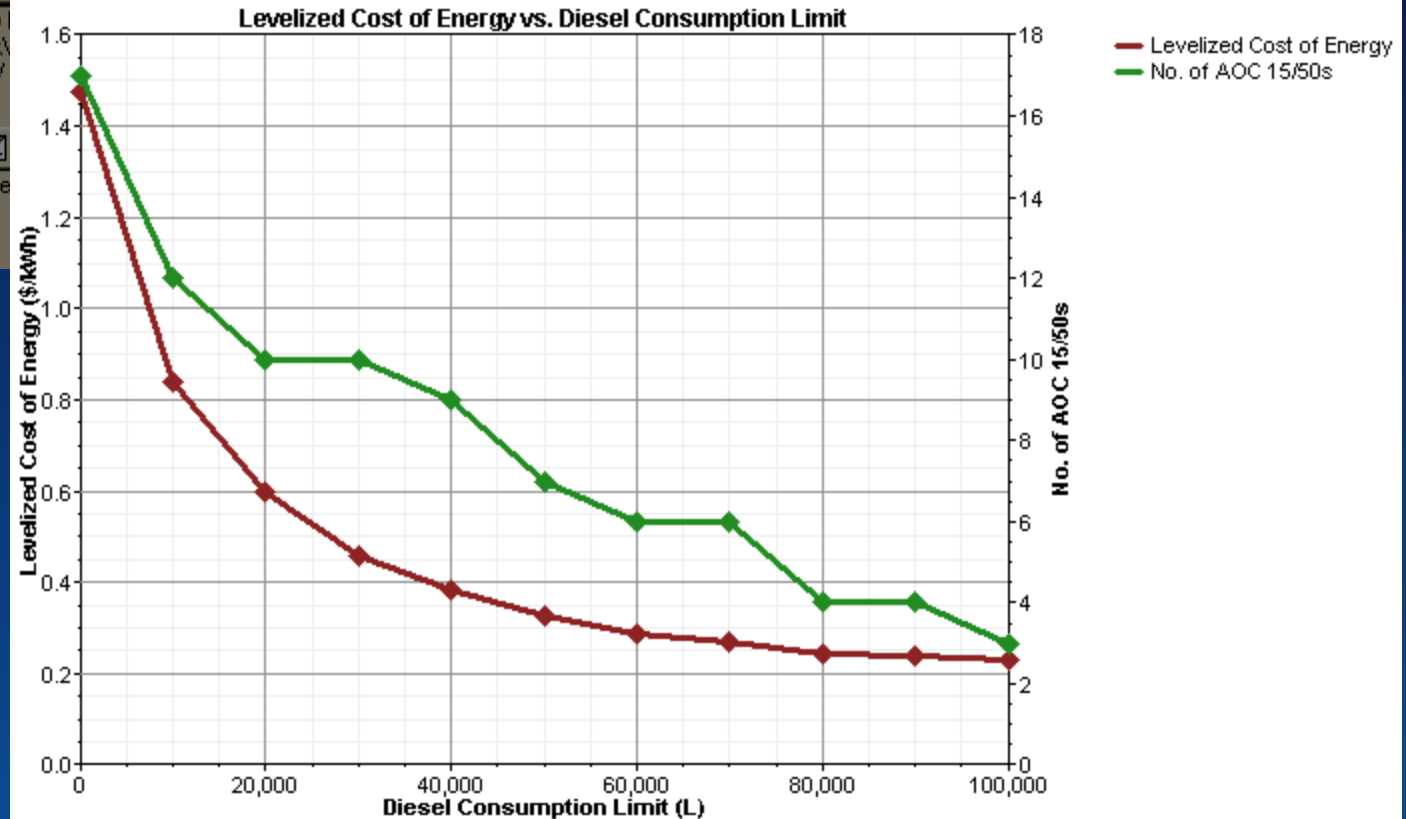
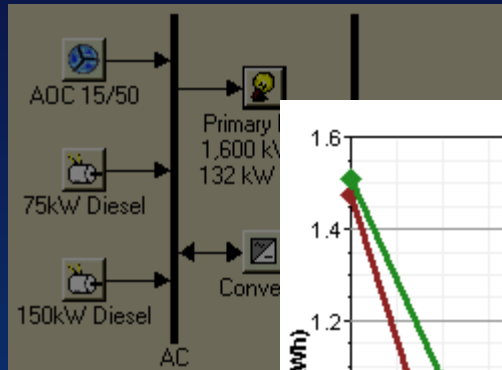


- Could I reduce fuel consumption?

Sensitivity Analysis Example



Sensitivity Analysis Example



New Features in Version 2.1

- Generator scheduling
- Fuel curve calculator
- Better wind resource modeling
- Better emissions modeling
- Linked to NASA solar data
- Output recycling
- Pretty HTML reports
- XML import/export

How do I get HOMER?

- It's free!
- www.nrel.gov/homer
- Simple registration form
- HOMER 2.1 beta version:
www.nrel.gov/homer/homer210beta.zip